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ABSTRACT

In the context of the development of a possible national mathematics assessment, a study was conducted to determine whether a test item characterization scheme could be created based on a state policy document that serves as the driving force behind large-scale performance assessment. Further considerations were whether such an item characterization scheme could provide a means to differentiate tasks within an assessment and produce equivalent assessment forms at various grade levels and whether the item characterization scheme could provide information comparable to that from previous item characterization approaches. These questions were explored using the California Learning Assessment System (CLAS) testing program. The Mathematics Framework for California Public Schools (CMF), the state's policy document for mathematics assessment, was used to create item characterizations and item signatures for CLAS tests. The CMF characterizations were compared to three other item characterization methods. No one scheme had a clear advantage in itself, but it was advantageous to use the state's own policy document as the basis for item characterization, in terms of time saved and costs avoided. Appendix A explains the coding schemes, and Appendix B presents the specific example of grade-8 test coding. (Contains one figure, one table, eight appendix tables, and eight references.) (SLD)

# Creating Item Signatures From California's Mathematics Framework: The First Step to Individual Result Reporting

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11 April 1996

by

John D. Leonard
University of California at Los Angeles
Graduate School of Education and Information Studies



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# Creating Item Signatures From California's Mathematics Framework: The First Step to Individual Result Reporting

John D. Leonard[1]
University of California at Los Angeles
Graduate School of Education and Information Studies

## The Background of Changing Assessment

Mathematics education is currently undergoing its third major reform in the past forty years. This reform, unlike the previous two, has its beginnings with the mathematics education community. States, like the mathematics education community, have become part of this reform by reasserting their control over the mathematics education within their borders through revised or new policy documents patterned after the National Council of Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards for School Mathematics*. As part of this reform, expectations of learning, the learning environment, and the tools to assess these facets of this reform are coming under scrutiny. California and Vermont, for example, have begun to develop and use large scale performance assessments to compare students to standards rather than traditional testing which rank orders students.

In cooperation with the mathematics community, states have included teachers and others not usually associated with assessment as part of the process of developing different ways of assessing student performance. This inclusion of a diverse population[2] in test development and the efforts to develop assessments to meet demands quite different from standardized, norm reference tests of the past, has created a need for ways to differentiate between test forms and characterize test items . Under these new conditions of student performance assessment, it becomes critical that students be given similar content items with comparable demands of performance in order to compare students performance to a standard. In situations where states such as California or Vermont have embarked on large scale performance assessments, means to distinguish content and performance are essential because the large scale performance assessments

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[1]This research was begun under the direction of Leigh Burstein who was the project Director of the CRESST School Delivery Standards Project, at the time of his untimely death. It is based on an amalgamation of ideas derived from (1) that project's work with the staff and technical advisory panel from the California Learning Assessment System (CLAS), (2) work done on the NSF Validating National Curriculum Indicators Project (McDonnell & Burstein; Mirocha, Ormseth, and Guiton as critical contributors ), and (3) the CCSSO SCASS Science Assessment Project.

[2] By diverse population, I am referring to parents and teachers. These groups are not usually a part of assessment development.

often (1) include multiple tasks and multiple test forms used for each grade and subject matter and (2) have a stated obligation to report performance levels for individual students when compared to a standard.

Thus, in the context of performance and content standards assessment development associated with current educational reform, we need a means for comparing, first, the content, second, the tasks, and, third, the different forms of a performance assessment. Without valid and reliable schemes for accomplishing these comparisons, the burden in producing comparable performance levels can lead to over reliance on empirical equating methods to compensate for differences in form content and difficulty. This over reliance on empirical methods would make it extremely unlikely that individual student results would be meaningful.

The term **item characterization** is often used to refer to the process of labeling a particular test item as to its content or other distinguishing characteristics[3]. In addition, the term **item signature** is used in this paper to refer to the various characteristics to an assessment item. When combined, all of the item signatures of a particular form of a multiple form assessment, provide a means to make meaningful comparisons between multiple forms. By using these signatures as a guide during the constructing of multiple forms of an assessments, the need for complex empirical methods should be lessened. It is assumed that these methods of characterizing assessment items could also be applied to other forms of assessment such as portfolios or other original documents (artifacts) produced by students and used as part of an evaluation scheme. Mathematics assessment in California[4], for example, had several forms of each test at three different grade levels with each containing an original artifact produced by students, as well as more traditional response items. In this instance, the task of characterizing items by content or performance expectation can be viewed as an effort by assessment creators to identify the "signature"[5] of a particular item[6].

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3 When this process is used in reference to artifacts other than test items, for example, student portfolios, assignments, or other documents, the term **coding** is used to indicate the actual labeling.

4 The CLAS (California Learning Assessment System) was being used when this investigation was conducted.

5 The signature concept was developed during the Survey of Mathematics and Science Opportunities Study (SMSO, 1993) conducted in connection with the Third International Mathematics and Science Study (TIMSS), as a means of applying the TIMSS multi-aspect, multi-dimensional curriculum framework to the characterization of the full array of content assessed by individual test items.

6 Although it is not part of this investigation, there is a need for a language system for describing, or preferably, characterizing assessments in a common way applies as well to instructional artifacts (classroom assessments, projects, exams, etc.) which have been collected from sites (classrooms, schools) attempting to implement reform or to the portfolio systems. There are schemes currently under development as an alternative means of monitoring student accomplishment. In these instances, the intent is to code artifacts/portfolios by established or developing rubrics to facilitate characterization of the performance they reflect and to provide a means of comparison to other assessment results.

**Sources For Characterization Schemes**

There are a variety of policy, subject matter, research and standards frameworks, documents, and statements that could serve as the basis for characterizing items of assessments and/or the coding of instructional artifacts. In academic area of mathematics, one could rely on, for instance, any of the following as the starting point for characterizing assessment items (creating item signatures).

1. NCTM Standards (1989);
2. TIMSS Curriculum Framework (TIMSS)(1993);
3. The survey categories from the Mathematics teacher survey (*questions 10, 11, 12, 15,16,17, and 21 have questions relevant to assessment (content and performance expectations) and assessment tasks (types of questions emphasized, goals that call for conjecturing, etc. ) of the McDonnell-Burstein NSF Validating National Indicators Project;
4. Reform Up Close Study Dimensions (Wisconsin Center for Education Research Porter (Porter, 1993); and
5. NAEP Achievement Levels Content Descriptors (Sugrue, 1994),

Daro (Daro, 1993), for example, has argued that any national assessment in mathematics must be based on the NCTM Curriculum and Evaluation Standards for School Mathematics (1989). Thus, in much the same spirit that Daro has suggested that national assessments be judged by the NCTM Standards, it is suggested that individual states should be judging their state mathematics program's assessments tools by item signatures based on the state's own policy document. Hence, item signatures based on the individual state's policy document could produce items closely aligned to the state's goals. California, for example, has a mathematics curriculum policy document, *Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve* (CMF), that has served as a driving force to change the assessment system of the state's mathematics program and could serve as a basis for item characterizations on state's mathematics assessments.

**The Scope of This Study**

This study was conducted to answer three questions:

(1) Can an item characterization scheme be created based on a state policy document when the policy document serves as the driving force behind large scale performance assessment?

(2) Does such an item characterization scheme provide a means to differentiate tasks within an assessment and produce equivalent assessment forms at various grade levels?

(3) Do the signatures based on such an item characterization scheme provide information comparable to previously mentioned existing methods of characterizing items?

Satisfying these three criteria, a state assessment scheme could be use to begin to report results that are meaningful individual student level without resorting to empirical analyses to equate tests containing differing content, performance tasks, etc.

**Rationale**

Because it is the intent of policy documents and state testing to include classroom teachers in the process of test development, a characterization scheme based on a state's policy document should be more easily used by teachers than the other mentioned schemes such as Porter, TIMSS. It is assumed that people working on items for such a state testing program would be familiar with the policy document and would therefore be able to use such a characterization with minimal training. Hence, an item characterization scheme based on the familiar document should shorten the process of assessment development.

The state of California was chosen for this investigation because California has such a document in its *Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve* (1985; 1992) and was beginning to move into the arena of large scale performance assessment with its CLAS testing program begun in 1992[7].

**Dimensions of Item Characterization**

There is a considerable history of item characterizing of assessments and item specifications of test forms in standardized test development. In California, for example, the State formed a panel to develop tests for grades 4, 8, and 10. The Performance Level Setting Group for the 1993 CLAS Grade 4 Mathematics assessment, drew on that history and produced a characterization protocol that included specific task features. The following are explanations of the characterization scheme produced from the 1985 CMF.

a. Strand - Major content strands from math framework. Each assessment item may be coded to reflect one of more strands that are represented in the item's content .

b. Task types - Each item is coded with a CR, SA/OE, or EMC to indicate whether it involves the student "choosing a response (CR)", short answer (SA), "open-ended" response called for (OE), or bubbling a result into a matrix of digits which is considered an "enhanced multiple choice" response.

[7] This CLAS program was terminated in 1994 by Governor Pete Wilson after negative public reaction to portions of the reading and writing sections of the statewide assessment.

c. Performance expectation/process characterization -- In this portion of an item's signature, the task is characterized by the process involved by the student in responding to the item. This part of an items signature indicates whether the response involves producing writing, "pictures", algorithmic procedures, or multiple representations in order to fully respond.

d. Other Comments -- Special features of an item that are worthy of note.

Using this California example as a specific case of an item characterization scheme, it can be generalized and elaborated in order to serve as the basis for identifying item signatures as do the previously mentioned schemes (NAEP, TIMSS, or Porter). Generalizing, there are four features of assessment tasks that contribute to an item's characterization and signature:

1. Content/topics -- This feature conveys the content dimension of the task expressed in conventional terminology. In many of the documents that might be used to produce rubrics, the terms "strand" and "unifying idea" better describe the intent of this feature.
2. Item type -- MC, open-ended, short answer (CLAS refers to CR/SA, EMC, and Open-Ended).
3. Process/Performance Expectation -- Whether one uses the conventional process term or performance expectation doesn't matter at this point. This feature refers to what one does mathematically or otherwise to perform the task rather than content of the item. In the reform discussions, this often is characterized as the "-ing" activities (conjecturing, comparing, contrasting, ...)[8].
4. Other/miscellaneous -- Response mode (picture, graph, written text, ...); the linguistic features of the prompt (i.e., judgments about the demands on recomprehension and vocabulary separate from specific mathematical content); other special features of the tasks that warrant note.

**Developing Signatures, Characterizations and Descriptions**

The signatures or characterizations used in this research examines the results of a scheme which was created by a teacher/researcher. The scheme devised was based on the previous work of the 1993 CLAS Performance Level Setting Group and the CMF. Once created, a panel of four individuals familiar with mathematics and the CMF were trained in one thirty minute session on the use of the scheme to create an individual item's signature. In subsequent meetings, individual item signatures for actual items

[8] One classic split is conceptual/declarative knowledge, procedural knowledge, and problem solving. Another alternative is to think of this dimension as a means of describing the cognitive demands of the task itself (what one has to know to be able to sensibly attempt the task) or the response the task engenders (in other words, what kind of response is called for).

from the 1993 CLAS examinations were made by the each member of the panel working independently. The resulting descriptions were compared and modifications to the scheme were made based on the suggestions of the panel.

Based on the discussions of this panel and the resulting item signatures of the characterization scheme, it was concluded that the CMF could be used as a basis for creating item signatures. A complete description of the signature criteria follows.

**Item Characterization Scheme Based on the CMF**

The final item characterization used in this investigation uses six components in an item's signature. These characterizations when combined form the signature of an individual item.[9] The categories or components used are:

a. Strand: The CMF mentions eight[10] content categories the permeate the mathematics program and have appeared in California mathematics frameworks for about 30 years. Each item may fit into one or more of these strand content categories: Functions, Algebra, Geometry, Statistics and Probability, Discrete Mathematics, Measurement, Number, and Logic and Language. A detailed description of these strands can be found on pages 75-87 of the CMF (1992).

b. Unifying Ideas: A unifying idea is a major mathematical theme relevant to or spanning several different strands. These unifying ideas emerge when a broader view of content is taken. Unifying ideas also indicate the depth of understanding appropriate to a grade level. There are ten unifying ideas with only a few at each of the grade-level groupings (K-5, 6-8, and 9-12). While each of the unifying ideas is relevant at later stages, the most emphasis and prominence are given to the unifying ideas being newly introduced at the grade level grouping (1992). These unifying ideas are discussed at each grade level in the CMF (grades K-5: pages 108-109; grades 6-8: pages 122-125; and grades 9-12: pages 158-163).

c. Task Type: The task type refers to the type of response solicited from the student. The categories used for the CLAS tests are OE for open-ended response item, MC for multiple-choice response item, EMC for extended multiple-choice item, and OTL was used to indicate an item assessing student reported "opportunity to learn" information. The EMC items require a student to "bubble" in the correct numerical answer on a grid of numbers rather than choose a given complete numerical answer.

[9] These are based on the 1985 and 1992 CMF's description of mathematics in grades K-12 envisioned in these documents.

[10] The eight strands are described on pages 80-87 of the 1992 CMF.

d. Performance Expectation: The CMF uses the phrase mathematical power which is described in this way: *Mathematically powerful students think and communicate, drawing on mathematical ideas and using mathematical tools and techniques.* Based on the further description in the CMF, these performance expectations can be used to characterize an assessment item[11]:

- *Thinking* refers to intellectual activity and includes analyzing, classifying, planning, comparing, investigating, designing, inferring and deducing, making hypotheses and mathematical models, and testing and verifying them. This expectation is not coded if an item involves applying an algorithm to a given situation where the activity consists of recognizing a situation for the use of the algorithm.
- *Communication* refers to coherent expression of one's mathematical processes and results. This is not coded in the case where a student is required to mark an answer.
- *Ideas* refers to content: mathematical concepts such as addition, proportional relationships, geometry, counting, and limits.
- *Tools and techniques* extend from literal tools such as calculators and compasses and their effective use to figurative tools such as computational algorithms and making visual representations of data.

e. Linguistic complexity: While the CMF makes no mention of linguistics, the concern for equity is prominent in the framework as noted concisely in the phrase, "... this document reasserts the goal of mathematical power for all students and emphasizes the phrase 'for all students.' ... giving every student in California fair access to mathematics education. Included are females and males; rich, poor, and middle class; descendants from all parts of the world; speakers of Mandarin, English, Arabic, Spanish, and the more than 200 other first languages of U. S. citizens." As a consequence of this, acknowledgment of the diversity of the California student population, it was deemed necessary to make some note of the linguistic feature of an item. A simple way is to characterize the linguistic complexity of an item is with an index of 'easily accessible for the grade level (EA.)', 'accessible for majority of grade level (A)'; or 'not accessible for most of grade level (NA)' for which the test is administered. This index and the term 'accessible' is one that is generally

[11] There are problems with this category which will be discussed at the end of this paper.

accepted by members of the Language Arts community and was used in the absence of others being currently developed.[12]

f. Other Comments: On occasion, an item is found to include phrases or words that might have either a cultural bias or might not be generally understood by the student population. This characterization category was included to alert those constructing items of possible problems. During sample coding sessions, remarks were included to refer to content when an item did not appear to fit into one or more of the previous signature categories.

For example, an item similar to the one listed in figure 1 was assigned this signature[13]:

| | |
|---|---|
| (a) STRAND: | Statistics and probability |
| (b) UNIFYING IDEAS: | Multiple representation & Finding, making, and describing patterns |
| (c) OE: | Open ended task |
| (d) PERFORMANCE EXPECTATION: | Thinking; Communication; Tools and techniques |
| (e) LINGUISTIC COMPLEXITY: | A |
| (f) OTHER COMMENTS: | None |

Figure 1 - (Similar to Eighth Grade CLAS Item)

*Information is collected and used for many different reasons. Some examples are:*

- *A company plans to report if there has been an increase in the recycling of newspapers.*
- *A company that makes bicycles wants to predict sales.*
- *The school PTA operates a snack bar at lunch and after school and wants to know how many of each kind of snacks to order.*

*You are responsible for writing a report to your class on ONE of the examples listed above. Explain how you would GATHER and ORGANIZE the information, and report your findings. You may use graphs, tables, or words to explain your answer.*

**Results of CMF Coding of Items and Forms**

After the initial revision, the characterization scheme produced the same signatures on 85% of the items of the assessment (80 items were examined on the eight forms of one level of the test). With the 15% that were not identical, four out of the five panelists agreed with the exception of one item which had only three of the five in

[12] Jamal Abedi is examining the linguistic features of mathematics items on assessments. This work may provide more descriptive ways to characterize items and, ultimately, provide the tools to create items that are easily accessible to the majority of students.

[13] The item was originally paraphrased to maintain the confidentiality of the examination.

agreement. With discussion, agreement was reached on all the remaining disputed items. These results satisfied the first question of this study: an item characterization can be created from a state policy document. In this study, the policy document used for the source of the item characterization scheme was the California Mathematics Framework.

While a single item's signature does not reveal the entire scope of an assessment, creating a matrix of each of the multiple forms of an assessment such as the Grade 8 CLAS test, does provide an indication of what student performance has been assessed by the sum of the items of that particular form of the assessment. Furthermore, with matrices of the multiple forms at one level, test designers can make between form comparisons and decisions about the comparability of the forms based on these item signatures. In the case of the Middle Grades Performance Assessment in Mathematics (Grade 8 CLAS test), comparison of the eight forms reveals that the multiple forms varied considerably on all categories thus making the task of having meaningful individual result reporting unlikely.

While coding individual items on samples of the assessment, coders were not aware of these differences. Once the matrix of the ten items of a form was created, over- and under- representations in each signature category became apparent. When all the form matrices were examined, it became apparent that (1) items needed to be moved between forms in order to balance various categories and (2) some items would need to be reworded to reflect the appropriate grade level emphasis stated in the CMF. Thus, had this signature scheme been in place, many of the criticisms directed at the test and, hence, indirectly at the committee that assembled the test, could have been avoided. It should be noted that in defense of the groups that created and assembled the various forms at the three levels, this was a concern that was expressed. But, unfortunately, in this instance, it appears that the committee had neither the time nor resources to deal with it. As with any new assessment, there is a learning curve associated with complexity of creating comparable test forms.[14] This last finding served to answer the second question of the study: such an item characterization does provide a means to compare tasks and could be used to produce equivalent forms of a large scale performance assessment.

A sample of the panel's coding of one grade level of the test is included in Appendix A. Also included in Appendix A is the same form coded with three other

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[14] The original expectation of the CLAS test was to produce first a performance based assessment that would monitor the successful adaptation of the mathematics program to the goals of the CMF. Second, the goal was to produce a test with individual student reportability. This process was in place as wa proceeding toward the goal of individual student reporting when the program was canceled.

characterization schemes to indicate the utility of each. Preceding each coding is an explanation of the characterization scheme.

**A Comparison of the CMF Signatures to Existing Methods of Item Characterization**

As mentioned previously, the final purpose of this investigation was to compare this signature scheme to existing item characterization schemes. For the purpose of this investigation, three other methods were used in this comparison. One was based on work by McDonnell & Burstein, a second using Porter's content dimensions, and the third using TIMSS signatures. Each of these coding schemes is described more fully in Appendix A. To facilitate comparisons between coding schemes and illustrate each, the item signatures for the question described in Figure 1, are shown in Table 1.

Observing the item's signature in each of the categories, a through f, gives an indication of the similarities of the various characterization schemes. It can be seen that each scheme gives an indication of the content of an item, the item response required, a description of the student process or performance, and includes comments as appropriate. Three signatures (McDonnell-Burstein, TIMSS, and Porter) have a much more comprehensive coverage of content as opposed to the scheme developed for this study. However, the CMF coding scheme, does have a category corresponding to the Unifying Ideas section of the framework. All four schemes reveal information about the particular item and, when combined with the signatures for all of the items of a particular form, would allow judgments to be made about the comparability among multiple forms in the categories of content and performance expectation. Since it is the purpose of a large scale performance assessment to produce valid reporting that avoids over reliance on empirical equating methods to compensate for differences in form content and performance expectations, it would be a first step to make use of an item's signature to build a particular form's signature that would produce forms with smaller differences in content and performance expectations.

To further illustrate the differences between characterization schemes and provide examples of the information to be gained from such form characterizations, Appendix B contains the coding for three forms of the Grade 8 CLAS Mathematics Assessment using the four item characterization schemes mentioned. When these three form's item signatures examined, all four schemes do show that there is variation between the three assessment forms in terms of content and performance tasks which was the third part of this research. This variation would increase the difficulty of meaningful individual reports. Thus, the characterization scheme based on the CMF does provide (1) a means for assessment panels to make grade level forms more representative of the goals of a particular grade level assessment and (2) a means to make forms within a grade level more equal in content and task demands.

**Table 1**

| CMF: | TIMSS: | McDonnell-Burstein: | Porter: |
|---|---|---|---|
| (a) Statistics and probability | (a) Data representation (1.7.1); Validation (1.9.2) | (a) Statistics and probability | (a) Number and number relations (0.9), Statistics(6.0) |
| (b) Multiple representation & Finding, making, and describing patterns; | (b) Not applicable to the TIMSS coding | (b) Not applicable in McDonnell-Burstein coding. | (b) Not applicable to Porter's coding |
| (c) OE; | (c) OE; | (c) OE; | (c) OE; |
| (d) Thinking; Communication; Tools and techniques; | (d) Knowing (2.1.1), PrblmSlvng (2.3.2, 2.3.2), Communication (2.5.3) | (d) Explain(d), Writing equations (sss) | (d) Interpret data (6) |
| (e) A | (e) Not used. | (e) Not used. | (e) Not used. |
| (f) No Comments. | (f) Students are to make a choice of which to answer. | (f) No Comments. | (f) Students are to make a choice of which question to answer. |

**Conclusions**

While each of the coding schemes provides differing information about individual items and forms through their signatures, each provides information that is valuable to test makers attempting to create performance assessments with comparable content and tasks. No one scheme has a clear advantage over another since each was designed for use by a specific group. In the case of a state, such as the case of California, there is a twofold advantage to using the policy document as the basis for item characterization. First of all, there would be the familiarity with the CMF which would theoretically shorten the time needed to create item signatures. Secondly, by lessening the development time, a cost savings to the assessment program should be realized. Finally, since such a coding scheme would be an extension of the ideas contained in the CMF, it would be more understandable to the state's mathematics education community and provide a model for individual districts in there own testing

development[15]. Once this scheme is more widely disseminated within a state, individual student scores can be reported and more easily understood.

**Implication for Future Work on Policy Document Based Item Signatures**

Based on the results of this investigation, it may be productive for individuals or groups of individuals in other states to develop signature schemes based on their state's policy documents if such a document exists. It might also be productive to create a item characterization scheme based on the NCTM Standards that could serve as a basis for individual state schemes.

In terms of the signature scheme developed in this investigation, there are ambiguities within the "unifying ideas", "performance expectation", and "linguistic complexity" categories. These ambiguities could be resolved by creating or further defining subcategories within each. The TIMSS characterization scheme may provide a useful starting place for deliniating content or the unifying idea characterization if this is desired. Linguistic complexity could be more clearly defined using schemes mentioned in the footnotes (Abedi, 1994).

All of the panelists agreed at the end of the sessions used to code the various forms that the performance expectation category "thinking" proved to be the least useful in the coding process. The description of the "thinking" category given in section d, could be used to further define the performance that a student's response should exemplify.

[15] Individual school districts in California are required to have a proficiency test which students must pass as a graduation requirement.

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## Appendix A

Sample coding
and
explanation of coding schemes.


| | |
|---|---|
| Coding of Form M0801 based on California Mathematics Framework | page 15 |
| Explanation of McDonnel & Burstein coding | pages 16-17 |
| Coding of Form M0801 by McDonnel & Burstein | pages 18 |
| Explanation of Porter coding | pages 19-22 |
| Coding of Form M0801 by Porter | page 23 |
| Explanation of TIMSS coding | pages 24-25 |
| Coding of Form M0801 by TIMSS | pages 26 |

**California Learning Assessment System**
Form Description/Characterization of
Grade 8, Mathematics **Form M0801**, Using California's Mathematics Framework

Section 1

| Item | (a) Strand | (b) Unifying Ideas | (c) Task Type | (d)[1] Performance expectation | (e) Linguistic complexity | (f)[2] Other Comments |
|---|---|---|---|---|---|---|
| 1 | Statistics and probability, Logic & Language | Multiple representations, Finding, making, and describing patterns; | OE | Thinking, Communication, Tools and techniques | EA | This question is an example of one that needs to specify a performance, i.e. "give an example of a graph that would be used in the report." |
| 2 | Number, Logic & Language | Patterns and generalization | OE | Thinking, Communication | A | - |

Section 2

| Item | Strand | Unifying Ideas | Task Type | Performance expectation | Linguistic complexity | Other Comments |
|---|---|---|---|---|---|---|
| 1 | Geometry | How many? How much? | EMC | Thinking | A | - |
| 2 | | | OTL | | | |
| 3 | Functions | Multiple representation | EMC | Thinking | EA | - |
| 4 | Number, Functions | How many? How much? | EMC | Thinking, Tools and techniques | EA | - |
| 5 | Geometry, Measurment | How many? How much? | EMC | Thinking | A | - |
| 6 | Statistics and probability | Multiple representation, Representing quantities and shapes | EMC | Thinking, Tools and techniques | A | - |
| 7 | Geometry, Number | Representing quantities and shapes | EMC | Thinking | EA | - |
| 8 | Number, Measurment | Proportional relationship, How many? How much? | EMC | Thinking, Tools and techniques | A | |

[1] Performance expectations are based on the Framework's Dimensions of Mathematical Power (CMF, pp. 20).
[2] The column headings, (a),...,(f), are those listed in "Characterizing Mathematics Assessments, Artifacts, and Portfolios (Signatures)" a work in progress from CRESST at UCLA.

**California Learning Assessment System**
Content Signatures, Grade 8, Mathematics
Using McDonnell-Burstein

Content signatures are taken from list of topics from items 10 and 11 in McDonnell-Burstein.

a. Patterns and functions
b. Estimation
c. Proportional reasoning
d. Proofs
e. Tables and charts
f. Graphing
g. Math modeling
h. Ratios, proportions, and percents
i. Conversions among fractions, decimals and percents
j. Laws of exponents
k. Square roots
l. Polynomials
m. Linear equations
n. Slope
o. Writing equations for lines
p. Inequalities
q. Quadratic equations
r. Applications of measurement formulas
s. Properties of geometric figures
t. Pythagorean Theorem
u. Coordinate geometry
v. Probability
w. Statistics
x. Distance, rate, time problems
y. Growth and decay

Student Understanding Levels are taken from McDonnell-Burstein item 12 and are coded as the second digit of content signature. For example, a question/task that is coded as "Proportional reasoning (c)" where a student is asked to be at level 3 (knows when and how to apply the rule or principle) would have a complete coding of "Proportional reasoning (c,3)". The levels used from item 12 are:

1 = Recognizes/knows the rule or principle
2 = When given the rule or principle, is able to use it
3 = Knows when and how to apply the rule or principle
4 = Can both apply the rule or principle and explain why it works as it does

**California Learning Assessment System**
Performance Level, Grade 8, Mathematics
Using McDonnell-Burstein

Performance signatures based on McDonnell-Burstein with items reworded to account for singular reference and appropriate syntax. Two samples of the rewording are included as footnotes.

From item 16:

a. recognizing or recalling definitions or concepts[3]
b. using of algorithms (similar to 23f: performing calculations with speed and accuracy, 23b: memorizing facts, rules, and steps, and 23h: solving equations)
c. describing how to solve problem[4] (similar to 23q: writing about mathematical ideas)
d. explaining reasoning (similar to 23i: raising questions and formulating conjectures)
e. application of concepts (principles) to different or unfamiliar situation (similar to 23t: solving problems for which there is no obvious method of solution)
f. critiquing or analyzing of solution to problem (similar to 23a: judging validity of arguments, 23m: finding examples and counterexamples, and 23a: understanding the nature of proof)

From item 17:

ee. using tabular or graphical data (similar to 23o: representing and analyzing relationships)

From item 23:

ccc. representing problem in multiple ways (e.g., graphically, algebraically, numerically)
sss. writing equations to represent relationships

[3] Original item, 16 a., reads "Items that require students to recognize or recall definitions of concepts"
[4] Original item, 23 q., reads "Writing about mathematical ideas"

## California Learning Assessment System

Form Description/Characterization of

Grade 8, Mathematics **Form M0801**, Using McDonnell-Burstein

Section 1 - (a)

| Item | (a) Content with level of student understanding | (c) Task Type | (d) Performance expectation | (e) Linguistic complexity[6] | (f)[5] Other Comments |
|---|---|---|---|---|---|
| 1 | Statistics (w,3) | OE | Explain(d), Writing equations (sss) | A | - |
| 2 | Graphing (f,3), Distance, rate, time problems (x,3), Laws of exponents (j,3) | OE | Critique(f) | A | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Applications of measurement formulas (r,3), Properties of geometric figures (s,1) | EMC | Application (e) | A | Use of fractions for sides may cause some students a problem if calculators are not available. |
| 2 | | OTL | | | |
| 3 | Applications of measurement formulas (r,1) | EMC | Application (e) | A | Involves partioning area |
| 4 | Distance, rate, time problems (x,3) | EMC | Concepts (a), Graph (ee), Application (e) | EA | Requires distance/time understanding |
| 5 | Applications of measurement formulas (r,3) | EMC | Concepts (a), Uses algorithm (b), Writing equations (sss) | A | Words "redesign" and "redesigned" may cause difficulty. |
| 6 | Patterns and functions (a,3) | EMC | Application (e), Uses algorithm (b) | A | - |
| 7 | Properties of geometric figures (s,1) | EMC | Concepts (a) | EA | 3D problem that is not easily characterized with content signatures |
| 8 | Proportional reasoning (c,3), Ratios, proportions, and percents (h,3) | EMC | Application (e) | A | Problem difficult to characterize because it is more computational than others |

5 The column headings, (a),...,(f), are those listed in "Characterizing Mathematics Assessments, Artifacts, and Portfolios (Signatures)" a work in progress from CRESST at UCLA.

6 The Linguistic complexity is denoted on a three point scale for the grade level: "Easily accessible, Accessible, Limited accessibility".

## California Learning Assessment System
Form Description/Characterization Porter's Dimensions

Porter's Dimension A category has ten content levels. Each of these ten content levels has a Dimension B (ten or fewer) levels nested within it. These Mathematics Content Codes/Dimensions are summarized below.

DimensionA: 0 Number and number relations
- Dimension B:
  - O: Sets/classification
  - 1: Whole number
  - 2: Ratio/proportion
  - 3: Percent
  - 4: Fractions
  - 5: Integers
  - 6: Exponents
  - 7: Decimals (incl. scientific notation)
  - 8: Real numbers (rational/irrational)
  - 9: Relations between numbers (order, magnitude)

DimensionA: 1 Arithmetic
- Dimension B:
  - O: whole numbers
  - 1: Ratio, Proportion
  - 2: percent
  - 3: Fractions
  - 4: integers
  - 5: Decimals
  - 6: Exponents
  - 7: Radicals
  - 8: Absolute value
  - 9: Relationships between operations

Dimension A: 2 Measurement
- Dimension B:
  - O: Time (not arithmetic-but units)
  - 1: Length
  - 2: Perimeter
  - 3: Area
  - 4: Volume (incl. capacity)
  - 5: Angle
  - 6: Weight
  - 7: Mass
  - 8: Rates (incl. derived and indirect)
  - 9: Relationships between measures

Dimension A: 3 Algebra
- Dimension B:
  - O: Variable
  - 1: Expressions
  - 2: Linear equations or inequalities
  - 3: Nonlinear equations or inequalities
  - 4: Systems of equations or inequalities
  - 5: Exponents or radicals
  - 6: Sequences or series
  - 7: Functions (polynomial)
  - 8: Matrices

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**California Learning Assessment System**
Form Description/Characterization Porter's Dimensions
(Continued)

Dimension A: 4 Geometry
Dimension B:
O: Point, line, segments, rays, angles
1: Relationship of lines; relationship of angles
2: Triangles and properties (incl. congruence)
3:Quadrilaterals (and polygons) and properties (incl. congruence)
4: Similarity
5: Symmetry
6: Circles
7: Solid geometry
8:coordinate geometry (incl. distance)
9:Transformations (informal or formal)

Dimension A: 5 Trigonometry
Dimension B:
O: Trigonometric ratios
1: Basic identities
2: Pythagorean identities
3: Solution of right triangles
4: Solution of right triangles
5: Trigonometric functions
6: Periodicity, amplitude, ....
7:Polar coordinates

DimensionA: 6 Statistics
Dimension B:
O: Collecting data
1: Distributional shapes (e.g., skew, symmetry)
2: Central tendency( e.g., mean, median, mode)
3: Variability (e.g., range, standard deviation)
4: Correlation or regression
5: Sampling
6: estimating parameters-(point est.)
7: Estimating parameters - (confidence intervals)
8: Hypothesis testing

Dimension A: 7 Probability
Dimension B:
O: Events, possible outcomes, trees
1: Equally likely - relative frequency prob.
2: Empirical probability (e.g., simulations)
3: Simple counting schemes (e.g., combinations an~ permutations)
4: Conditional probability
5: Discrete distributions - binomial
6: Discrete distributions - other
7: Continuous distributions - normal
8: Continuous distributions - other

**California Learning Assessment System**

Form Description/Characterization Porter's Dimensions (Continued)

Dimension A: 8 Advanced Algebra/ Precalculus / Calculus

Dimension B:
- O: Functional notation and properties
- 1: Operations with functions
- 2: Polynomial functions
- 3: Exponential functions
- 4: Logarithmic functions
- 5: Relations between types of functions
- 6: Matrix algebra
- 7: Limits and continuity
- 8: Differentiation
- 9: Integration

Dimension A: 9 Finite/Discrete Mathematics

Dimension B:
- O: Sets (e.g., union, intersection, Venn diagrams)
- 1: Logic (truth values, logical argument forms, sentence logic, .... )
- 2: Business math (interest, insurance .... )
- 3: Linear programming
- 4: Networks
- 5: Iteration and recursion
- 6: Markov chains
- 7: Development of computer algorithms
- 8: Mathematical modeling

Dimension C represents "mode of instruction" (seven levels) and is not included in the assessment characterization because it does not apply to the assessment situation.

**California Learning Assessment System**
Form Description/Characterization Porter's Dimensions

Dimension D categories that follow represent the type/levels of knowledge or skills that a student are expected to exhibit and are taken from Defining and Measuring Opportunity to Learn by Andrew C. Porter. The paper was prepared for the National Governors' Association on 25 May 1993 with the empirical work reported in the second half of the paper based on a study, Reform Up Close: A Classroom Analysis which was funded by the National Science Foundation and administered through the Center for Policy Research in Education and the Wisconsin Center for Education Research. In the coding process, since Potter's Dimension D are in the form on a Taxonomy from lower to higher levels, each item was coded with only the highest level reached in the item. Thus, it is assumed that lower levels are probably present.

Dimension D:

0 Memorize facts/definitions/equations
1 Understand concepts
2 Collect data
3 Order, compare, estimate, approximate
4 Perform procedures: execute algorithms/routine procedures (including factoring), classify
5 Solve routine problems, replicate experiments/replicate proofs
6 Interpret data, recognize patterns
7 Recognize, formulate, and solve novel problems/design experiments
8 Build and revise theory/develop proofs

3?     3?

**California Learning Assessment System**
Form Description/Characterization
Grade 8, Mathematics **Form M0801** Using Porter's Dimensions

Section 1 - (a)

| Item | Content | (c) Task Type | (d) Performance expectation | (e) Linguistic complexity[8] | (f)[7] Other Comments |
|---|---|---|---|---|---|
| 1 | Number and number relations (0.9), Statistics(6.0) | OE | Interpret data (6) | A | Students are to make a choice of which question to answer. |
| 2 | Number and number relations (0.9, 0.8), Arithmetic (1.3, 1.5) | OE | Build and revise theory (8) | A | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Measurement (2.3, 2.4), Algebra (3.2), Geometry (4.3) | EMC | Perfrm prcdrs (4) | A | Use of fractions for sides may cause some students a problem if calculators are not available. |
| 2 | | OTL | | | |
| 3 | Measurement (2.3), Geometry (4.3) | EMC | Recognize,frmlt, slv novel prbm(7) | A | Involves partitioning area. |
| 4 | Measurement (2.8), Finite/Discrete (9.2) | EMC | Intrprt data, rcgnz pttrns (6) | EA | Requires distance/time understanding |
| 5 | Measurement (2.3), Geometry (4.3) | EMC | Perfrm prcdrs (4) | A | |
| 6 | Arithmetic (1.0), Probability (7.3) | EMC | Perfrm prcdrs (4) | A | |
| 7 | Geometry (4.3) | EMC | Intrprt data, rcgnz pttrns (6) | EA | |
| 8 | Arithmetic (1.0), Measurement (2.8) | EMC | Perfrm prcdrs (4) | A | |

[7] The column headings, (a),...,(f), are those listed in "Characterizing Mathematics Assessments, Artifacts, and Portfolios (Signatures)" a work in progress from CRESST at UCLA.
[8] The Linguistic complexity is denoted on a three point scale for the grade level: "Easily accessible, Accessible, Limited accessibility".

**California Learning Assessment System**
Form Description/Characterization For Mathematics Using TIMSS Aspects[9]

Content Aspect

1.1 Number
- 1.1.1 Whole number
- 1.1.2 Fractions and decimals
- 1.1.3 Integer, rational, and real number
- 1.1.4 Other numbers and number concepts
- 1.1.5 Estimation and number sense

1.2 Measurement
- 1.2.1 Units
- 1.2.2 Perimeter, area, and volume
- 1.2.3 Estimation and error

1.3 Geometry: position, visualization, and shape
- 1.3.1 Two-dimensional geometry: coordinate geometry
- 1.3.2 Two-dimensional geometry: basics
- 1.3.3 Two-dimensional geometry: polygons and circles
- 1.3.4 Three-dimensional geometry
- 1.3.5 Vectors

1.4 Geometry: symmetry, congruence, and similarity
- 1.4.1 Transformations
- 1.4.2 Congruence and similarity
- 1.4.3 Constructions using straight-edge and compass

1.5 Proportionality
- 1.5.1 Proportionality concepts
- 1.5.2 Proportionality problems
- 1.5.3 Slope and trigonometry
- 1.5.4 Linear interpolation and extrapolation

1.6 Functions, relations, and equations
- 1.6.1 Patterns, relations, and functions
- 1.6.2 Equations and formulas

1.7 Data representation, probability, and statistics
- 1.7.1 Data representation and analysis
- 1.7.2 Uncertainty and probability

1.8 Elementary analysis
- 1.8.1 Infinite processes
- 1.8.2 Change

1.9 Validation and structure
- 1.9.1 Validation and justification
- 1.9.2 Structuring and abstracting

1.10 Other content
- 1.10.1 Informatics

[9] The sections that follow contain a breakdown of the TIMSS mathematics framework into two of its three aspects or dimensions: Content, Performance expectations, and Perspectives. Perspectives is omitted in this analysis.

**California Learning Assessment System**

Form Description/Characterization For Mathematics Using TIMSS Aspects

Performance signatures (expectations) based on TIMSS levels:

21. Knowing
    - 2.1.1 Representing
    - 2.1.2 Recognizing equivalents
    - 2.1.3 Recalling mathematical objects and properties

2.2 Using routine procedures
    - 2.2.1 Using equipment
    - 2.2.2 Performing routine procedures
    - 2.2.3 Using more complex problems

2.3 Investigating and problem solving
    - 2.3.1 Formulating and clarifying problems and situations
    - 2.3.2 Developing strategy
    - 2.3.3 Solving
    - 2.3.4 Predicting
    - 2.3.5 Verifying

2.4 Mathematical reasoning
    - 2.4.1 Developing notation and vocabulary
    - 2.4.2 Developing algorithms
    - 2.4.3 Generalizing
    - 2.4.4 Conjecturing
    - 2.4.5 Justifying and proving
    - 2.4.6 Axiomatizing

2.5 Communicating
    - 2.5.1 Using vocabulary and notation
    - 2.5.2 Relating representations
    - 2.5.3 Describing/discussing
    - 2.5.4 Critiquing

**California Learning Assessment System**
Form Description/Characterization
Grade 8, Mathematics **Form M0801** Using TIMSS Aspects

Section 1 - (a)

| | | (c) | (d) | (e) | (f)[10] |
|---|---|---|---|---|---|
| Item | Content | Task Type | Performance expectation | Linguistic complexity[11] | Other Comments |
| 1 | Data representation (1.7.1) | OE | Communicating (2.5.1, 2.5.2, 2.5.3) | A | Students are to make a choice of which question to answer. |
| 2 | Number (1.1.1, 1.1 2, 1.1.5) | OE | Reasoning (2.4.3), Communicating (2.5.2, 2.5.3), Routine (2.2.2), PrblmSlvng(2.3.1, 2.3.2, 2.3.5) | A | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Number (1.1.2, 1.1.5), Measurement (1.2.2) | EMC | Knowing ( 2.1.3), Routine (2.2.3, 2.2.2) | EA | Use of fractions for sides may cause some students a problem if calculators are not available. |
| 2 | OTL | OTL | OTL | OTL | OTL |
| 3 | Measurement (1.2.2) | EMC | Knowing (2.1.3), PrblmSlvng(2.3.1, 2.3.2), Reasoning (2.4.3) | EA | Involves partioning area. |
| 4 | Data representation (1.7.1) | EMC | Knowing (2.1.3), Routine (2.2.3) | A | Requires distance/time understanding |
| 5 | Function(1.6.2), Geometry (1.3.2), Measurement (1.2.2) | EMC | PrblmSlvng(2.3.1, 2.3.3) | A | Words "redesign" and "redesigned" may cause difficulty. |
| 6 | Functions (1.6.1) | EMC | Knowing (2.1.2), PrblmSlvng(2.3.1) | A | - |
| 7 | Geometry (1.3.4) | EMC | Knowing (2.1.3), Routine (2.2.3) | A | - |
| 8 | Measurement (1.2.1), Proportionality (1.5.1) | EMC | PrblmSlvng (2.3.1, 2.3.2, 2.3.3) | A | - |

[10] The column headings, (a),...,(f), are those listed in "Characterizing Mathematics Assessments, Artifacts, and Portfolios (Signatures)" a work in progress from CRESST at UCLA.
[11] The Linguistic complexity is denoted on a three point scale for the grade level: "Easily accessible, Accessible, Limited accessibility".

## Appendix B

Coding of Grade 8, Mathematics of the
California Learning Assessment System


| | |
|---|---|
| Coding of Forms M0802-M0803 based on California Mathematics Framework | pages 28-29 |
| Coding of Forms M0802-M0803 based on McDonnel & Burstein | pages 30-31 |
| Coding of Forms M0802-M0803 based on Porter | pages 32-33 |
| Coding of Forms M0802-M0803 based on TIMSS | pages 34-35 |

**California Learning Assessment System**
Form Description/Characterization of
Grade 8, Mathematics **Form M0802**, Using California's Mathematics Framework

Section 1 - (a) (b) (c) (d)[1] (e) (f)[2]

| Item | Strand | Unifying Ideas | Task Type | Performance expectation | Linguistic complexity | Other Comments |
|---|---|---|---|---|---|---|
| 1 | Number, Logic & Language, Algebra, Functions, Discrete math | Patterns and generalization, Finding, making, and describing patterns | OE | Thinking, Communication, Tools and techniques | A | - |
| 2 | Number, Logic & Language | Multiple representations, How many? and How much? | OE | Thinking, Communication, Tools and techniques | A | - |

Section 2

| Item | Strand | Unifying Ideas | Task Type | Performance expectation | Linguistic complexity | Other Comments |
|---|---|---|---|---|---|---|
| 1 | Geometry, Algebra | Representing quantities and shapes, Patterns and generalization | EMC | Thinking | EA | Involves partitioning area |
| 2 | | | OTL | | OTL | OTL |
| 3 | Geometry | Multiple representation | EMC | Thinking | EA | - |
| 4 | Statistics and probability | Patterns and generalization | EMC | Thinking | A | Students need to interpret graphical data |
| 5 | Geometry, Algebra | Patterns and generalization | EMC | Thinking | EA | - |
| 6 | Number, Statistics and probability | Patterns and generalization | EMC | Thinking | A | - |
| 7 | Geometry | Representing quantities and shapes | EMC | Thinking | EA | - |
| 8 | Number, Measurement | Proportional Relationships | EMC | Thinking, Tools and techniques | A | - |

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**California Learning Assessment System**
Form Description/Characterization of
Grade 8, Mathematics **Form M0803**, Using California's Mathematics Framework

Section 1

| (a) Item | Strand | (b) Unifying Ideas | (c) Task Type | (d)[1] Performance expectation | (e) Linguistic complexity | (f)[2] Other Comments |
|---|---|---|---|---|---|---|
| 1 | Number, Logic and language, Algebra, Functions, Discrete math | Patterns and generalization, Finding, making, and describing patterns | OE | Thinking, Communication, Tools and techniques | A | - |
| 2 | Functions, Logic and language, Discrete math | Patterns and generalization, Finding, making, and describing patterns | OE | Thinking, Communication, Tools and techniques | EA | - |

Section 2

| Item | Strand | Unifying Ideas | Task Type | Performance expectation | Linguistic complexity | Other Comments |
|---|---|---|---|---|---|---|
| 1 | Geometry, Logic and Language | Representing quantities and shapes, Patterns and generalization | EMC | Thinking, Tools and techniques | EA | - |
| 2 | OTL | OTL | OTL | OTL | OTL | OTL |
| 3 | Algebra, Functions | Finding, making, and describing patterns | EMC | Thinking | A | - |
| 4 | Number, Statistics and probability | Representing quantities and shapes | EMC | Thinking | A | - |
| 5 | Geometry | Multiple representation | EMC | Thinking | A | - |
| 6 | Algebra, Statistics and probability | Multiple representation | EMC | Thinking | A | - |
| 7 | Geometry | Multiple representation | EMC | Thinking, Tools and techniques | EA | - |
| 8 | Number, Algebra | Patterns and generalization | EMC | Thinking, Tools and techniques | EA | - |



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**California Learning Assessment System**
Form Description/Characterization of
Grade 8, Mathematics **Form M0802**, Using McDonnell-Burstein

Section 1 - (a)

| | (a) | (c) | (d) | (e) | (f)[1] |
|---|---|---|---|---|---|
| Item | Content with level of student understanding | Task Type | Performance expectation | Linguistic complexity[2] | Other Comments |
| 1 | Patterns, functions(a,3) | OE | Concepts (a), Explain(d), Application (e), Representing in Multile Ways(ccc) | A | - |
| 2 | Patterns, functions(a,3) Probability (v,3) | OE | Concepts (a), Explain(d), Representing in Multile Ways(ccc) | A | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Properties of geometric figures (s,3) | EMC | Application (e) | EA | Involves partitioning area |
| 2 | | OTL | | | |
| 3 | Patterns, functions(a,3) | EMC | Application (e), Representing in Multiple Ways(ccc) | EA | - |
| 4 | Statistics (w,3), Proportional reasoning (c,3) | EMC | Concepts (a), Application (e), Graph (ee) | EA | - |
| 5 | Applications of measurement formulas (r,3), Proportional reasoning (c,3) | EMC | Concepts (a), Graph (ee) | EA | - |
| 6 | Statistics (w,3) | EMC | Concepts (a), Representing in Multiple Ways(ccc) | A | - |
| 7 | Properties of geometric figures (s,1), Applications of measurement formulas (r,1), Patterns and functions (a,3) | EMC | Concepts (a), Graph (ee) | EA | 3D problem that is not easily characterized with content signatures |
| 8 | Proportional reasoning (c,3), Conversions fractions, decimals, percents(i,3) | EMC | Concepts (a), Application (e), Representing in Multiple Ways(ccc) | A | - |

**California Learning Assessment System**
Form Description/Characterization of
Grade 8, Mathematics **Form M0803**, Using McDonnell-Burstein

Section 1 - (a)

| Item | (a) Content with level of student understanding | (c) Task Type | (d) Performance expectation | (e) Linguistic complexity[2] | (f)[1] Other Comments |
|---|---|---|---|---|---|
| 1 | Proportional reasoning (c,3) | OE | Concepts (a), Explain(d), Writing equations (sss) | A | - |
| 2 | Patterns and functions (a,4) | OE | Explain(d), Using graphs (ee) | EA | - |

Section 2

| Item | Content with level of student understanding | Task Type | Performance expectation | Linguistic complexity | Other Comments |
|---|---|---|---|---|---|
| 1 | Applications of measurement formulas (r,3), Properties of geometric figures (s,3) | EMC | Concepts (a), Using graphs (ee) | EA | - |
| 2 | OTL | OTL | OTL | OTL | OTL |
| 3 | Patterns and functions (a,3) | EMC | Using graphs (ee) | A | - |
| 4 | Statistics (w,3), Proportional reasoning (c,3) | EMC | Concepts (a), Using graphs (ee) | A | - |
| 5 | Coordinate Geomety (u,3) | EMC | Concepts (a), Applications (e) | A | - |
| 6 | Probability (v,3), Proportional reasoning (c,3) | EMC | Concepts (a), Applications (e) | A | - |
| 7 | Coordinate Geomety (u,3) | EMC | Concepts (a), Representing in Multiple Ways(ccc) | EA | - |
| 8 | Patterns and functions (a,3) | EMC | Algorithms (b), Representing in Multiple Ways(ccc), Writing Equations (sss) | EA | - |

**California Learning Assessment System**
Form Description/Characterization
Grade 8, Mathematics **Form M0802** Using Porter's Dimensions

Section 1 - (a)

| Item | Content | (c) Task Type | (d) Performance expectation | (e) Linguistic complexity[2] | (f)[1] Other Comments |
|---|---|---|---|---|---|
| 1 | Algebra (3.6) | OE | Recognize,frmlt, slv novel prbm(7) | A | - |
| 2 | Probability (7,2) | OE | Recognize,frmlt, slv novel prbm(7) | A | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Measurement (2.3), Geometry (4.3) | EMC | Interpret data (6) | EA | Involves partitioning area |
| 2 | OTL | OTL | OTL | OTL | OTL |
| 3 | Algebra (3.6) | EMC | Interpret data (6) | EA | - |
| 4 | Arithmetic(1,1) | EMC | Solve routine problems (5) | A | Students need to interpret graphical data |
| 5 | Measurement (2.2), Geometry (4.2) | EMC | Order,cmpr,est(3) | EA | - |
| 6 | Probability (7.1) | EMC | Collect data (2) | A | - |
| 7 | Geometry (4.3), Measurement (2.4) | EMC | Intrprt data, rcgnz pttrns (6) | EA | - |
| 8 | Arithmetic (1.0), (1.3) | EMC | Perfrm prcdrs (4) | A | - |



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**California Learning Assessment System**
Form Description/Characterization
Grade 8, Mathematics **Form M0803** Using Porter's Dimensions

Section 1 - (a)

| Item | Content | (c) Task Type | (d) Performance expectation | (e) Linguistic complexity[2] | (f)[1] Other Comments |
|---|---|---|---|---|---|
| 1 | Number and number relations (0.2), Arithmetic (1.1) | OE | Recognize,frmlt, slv novel prbm(7) | A | - |
| 2 | Algebra (3.6) | OE | Interpret data, recognize patterns (6) | EA | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Measurement (2.3) | EMC | Order,cmpr,est(3) | EA | - |
| 2 | OTL | OTL | OTL | OTL | OTL |
| 3 | Algebra (3.1) | EMC | Recognize,frmlt, slv novel prbm(7) | A | - |
| 4 | Statistics (6,0) | EMC | Intrprt data, rcgnz pttrns (6) | A | - |
| 5 | Geometry (4.3), (4,8) | EMC | Recognize,frmlt, slv novel prbm(7) | A | - |
| 6 | Arithmetic (1.1), Probability (7.0) | EMC | Perfrm prcdrs (4) | A | - |
| 7 | Geometry (4.1) | EMC | UndConcepts(1) | EA | - |
| 8 | Arithmetic (1.5) | EMC | Solve routine problems (5) | EA | - |

**California Learning Assessment System**
Form Description/Characterization
Grade 8, Mathematics **Form M0802** Using TIMSS Aspects

Section 1

| Item | (a) Content | (b) Task Type | (c) Performance expectation | (d) Linguistic complexity | (e) Other Comments |
|---|---|---|---|---|---|
| 1 | Functions(1.6.1), Elementary Analysis (1.8.1) | OE | Investigating (2.3.1, 2.3.2, 2.3.3), Reasoning (2.4.3), Communicating (2.5.3) | A | - |
| 2 | Data representation (1.7.1), Number (1.1.1), Function (1.6.1) | OE | Investigating (2.3.1), Reasoning (2.4.3), Communicating (2.5.2, 2.5.3) | A | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Measureme nt (1.2.2) | EMC | Investigating (2.3.3) | EA | - |
| 2 | OTL | OTL | OTL | OTL | OTL |
| 3 | Functions(1.6.1) | EMC | Reasoning (2.4.3) | EA | - |
| 4 | Proportionality (1.5.2), Data representation (1.7.1) | EMC | Investigating (2.3.1, 2.3.3) | A | - |
| 5 | Geometry (1.4.2) | EMC | Investigating (2.3.3) | A | - |
| 6 | Data representation (1.7.2) | EMC | Investigating (2.3.3) | A | - |
| 7 | Geometry (1.3.4) | EMC | Investigating (2.3.3) | A | - |
| 8 | Functions(1.6.2) | EMC | Investigating (2.3.2, 2.3.3) | A | - |

**California Learning Assessment System**
Form Description/Characterization
Grade 8, Mathematics **Form M0803** Using TIMSS Aspects

Section 1

| | (a) | (b) | (c) | (d) | (e) |
|---|---|---|---|---|---|
| Item | Content | Task Type | Performance expectation | Linguistic complexity | Other Comments |
| 1 | Proportionality (1.5.2), | OE | Investigating (2.3.2, 2.3.3), Communicating (2.5.2, 2.5.3) | A | - |
| 2 | Elementary analysis (1.8.1), Function (1.6.1, 1.6.2) | OE | Investigating (2.3.1), Reasoning (2.4.3), Communicating (2.5.1, 2.5.2, 2.5.3) | A | - |

Section 2

| | | | | | |
|---|---|---|---|---|---|
| 1 | Measureme nt (1.2.2) | EMC | Routine (2.2.2), Investigating (2.3.3) | EA | - |
| 2 | OTL | OTL | OTL | OTL | OTL |
| 3 | Functions(1.6.2) | EMC | Investigating (2.3.3) | EA | - |
| 4 | Proportionality (1.5.1), Data representation (1.7.1) | EMC | Knowing (2.1.2), Investigating (2.3.3) | A | - |
| 5 | Geometry (1.3.1, 1.4.1) | EMC | Knowing (2.1.3), Investigating (2.3.3) | A | - |
| 6 | Data representation (1.7.2), Proportionality (1.5.2) | EMC | Investigating (2.3.2, 2.3.3) | A | - |
| 7 | Geometry (1.3.1, 1.3.5) | EMC | Investigating (2.3.3) | A | - |
| 8 | Number (1.1.4), Functions(1.6.2) | EMC | Investigating ( 2.3.3) | A | - |